

XXXVII.—*On the Species and Varieties of the Honey-Bees belonging to the Genus Apis.* By FREDERICK SMITH.

[Plate XIX.]

IN 1862 Dr. Gerstäcker published his remarks "On the Geographical Distribution and Varieties of the Honey-Bee, with Observations upon the Exotic Honey-Bees of the Old World"*. Having in my own possession a large amount of material, and also access to that preserved in other collections, I have devoted considerable time to an attentive study of the species. The result has been somewhat different from that arrived at by Dr. Gerstäcker. I have therefore thought it might be desirable that I should publish the results of my own study of the genus.

In my 'Catalogue of the Apidæ' I enumerated fifteen species of the genus *Apis*: one was overlooked at that time, and four I have described since its publication, thus increasing the number to twenty species. In the paper referred to, the fifteen catalogued species, with the addition of two of those which I have subsequently described, are reduced to four by Dr. Gerstäcker: why he passed over the other two, which I described previous to those he has noticed, it is difficult to imagine; but it was probably entirely an oversight. I fully concur in the necessity for the reduction of the number of species effected by this learned entomologist; but I am not prepared to go with him to the same extent: I must therefore endeavour to show good reasons for differing from such an authority.

Our author remarks that "various races of Honey-Bees have been described as distinct species by various authors," but that "they really present no distinctive specific characters." This observation naturally leads to the inquiry, What are the distinctive specific characters in the genus *Apis*? Before I attempt to answer that question I would offer a few remarks upon two or three distinct and extensive genera of Bees, and will endeavour to point out where, under certain conditions, distinctive characters are sometimes to be found. If I were to seek in the females of many species of Bees for the distinctive characters of the species, either in difference of form or in the sculpture of parts, I should in all probability fail to discover any that I could, by description, enable the entomologist easily to recognize; but if I had each species before me in its *entirety*, that is, both sexes of each species, my task would in all probability become a comparatively easy one. My knowledge of the male and female of each species would place me in a position to enter upon the investigation with the necessary materials before me. I should, in the first place, probably find broad and distinctive differences

* Annals, ser. 3. vol. xi. p. 270.

in the males which I could not detect in the other sex; and I should then be able to determine what (however slight they might be) were the distinguishing characters of the females—differences which, under other circumstances, I might probably have regarded as mere marks of variation; but these would then be recognized as characters of full specific value, such as a description would easily point out. This position would apply admirably to many species in the genera *Megachile*, *Osmia*, and *Xylocopa*: the females in these genera are frequently extremely difficult to separate into species; but when we become acquainted with each in its entirety, the difficulty is at once removed. The male sex in these genera frequently presents marked differences of form in the legs, at other times in the armature of the head with horns or spines. In the extensive genus *Nomada* we are frequently compelled to rely for specific distinctions upon differences in coloration, scarcely any presenting themselves in the structural characters of either sex.

The remark that “Honey-Bees really present no distinctive specific characters” would be perfectly true if applied only to *worker Bees*; for, with the exception of difference of size and coloration, no other very satisfactory characters are to be found: one species only would be readily separable from the rest—the *Apis dorsata*, it having a constant distinct difference in the neururation of the anterior wings, and also in the size and position of the ocelli.

What, then, are the distinctive specific characters in the genus *Apis*? These are to be found only in the *entirety of the species*; and I am perfectly convinced that attempts to determine what are species, and what are races, by a study of the *workers only*, must result in the commission of error—little more than difference of size and variety in coloration being the guides for determination.

Dr. Gerstäcker’s remark must therefore be understood, in my opinion, as only applicable to the study of the working Bees—by far the least characteristic form of the species. *Apis mellifica* appears to be the only species of which Dr. Gerstäcker knows the *undoubted male*; it is true that he has assigned my species *Apis lobata*, established upon a solitary specimen in the national collection (and in all probability it is correctly assigned), to the Fabrician *Apis florea*, having received both in a collection from Ceylon. I myself possess the males of three species, and a fourth is in the British Museum: each of them is distinguished by strongly marked distinctive specific characters; so that no hesitation can possibly be felt about assigning each to a distinct species of Honey-Bee.

As before observed, I enumerated fifteen species of the genus

Apis in my catalogue; but at that time, I must admit, I had very strong suspicions of several being mere climatal varieties of the others, such varieties as might be reasonably expected to be found in communities of the species; but I felt that I had little or nothing to guide me in arriving at a more correct enumeration. I might have arbitrarily reduced the number, it is true; but such a mode of reduction I felt I was not warranted in making; in fact, I found that, until I became acquainted with the other sexes of these *supposed varieties*, it was far better to let them stand as species until more ample and necessary material presented itself to work upon.

The possession of an extensive series of examples of any species from different localities is doubtless good material for tracing out the variation in colour to which a species is liable. *Apis mellifica* would be an instance of this kind, pregnant in interest. But, at the same time, I must claim, for a series such as I have indicated, that it is a means whereby we may also trace the variation in size to which any species is liable. Therefore, if I investigate *Apis mellifica* in this respect, and examine a large series of examples from all parts of Europe, I include the *Apis ligustica* as a mere variety; and, as I have just observed, my series being extensive and from all parts of Europe, from the Cape of Good Hope, from Natal, Sierra Leone, Australia, New Zealand, from St. Domingo, the Sandwich Islands, also from distant parts of North America, when I compare all these together, I find no really perceptible difference in size in the whole series before me.

In the next place I examine a very extensive series of Honey-Bees from different parts of Africa, and I at once recognize many of *Apis mellifica*, all agreeing as to size, but exhibiting not only the dark unicolorous Bee of northern Europe, but also an extremely bright variety of *Apis ligustica*. I next find a large number of a bright-coloured species, closely resembling *A. ligustica*, but all being uniformly of a much smaller size: this is Latreille's species, *Apis Adansonii*. Varieties of this Bee are described by St. Fargeau under the names *A. scutellata*, *A. nigritarum*, and *A. Caffra*. I entertain little doubt of these three supposed species being varieties of *A. Adansonii*; but until all the sexes of this smaller Bee are obtained, and the males are found to be identical with those of *A. mellifica*, I shall regard the *A. Adansonii* as a good and very distinct species.

My investigation of the genus *Apis* induces me to divide it into seven species: I enumerate eight, but one is founded upon a single example of a drone: this male is from North China, whence I also obtained a worker of my own species, *Apis nigrocincta*; therefore it is highly probable it may prove to be the male of that species.

Dr. Gerstäcker's history of the geographical distribution of the *Apis mellifica* is extremely interesting; but, in my opinion, he has included, as I before stated, a distinct species, the *Apis Adansonii*. I can add somewhat to the range of the European Bee, as our author says "it does not appear to exist in Australia;" it is, however, I am informed, extremely abundant in that country, both in a domestic and also in a wild state; it has, of course, been introduced. It is found in the same way in New Zealand. In the British Museum are examples of *Apis Adansonii* from Australia. The Northern Honey-Bee abounds, in a wild state, in Texas and California; indeed Mr. Lord, who was resident in the former country for a considerable period, told me that it would be very difficult, perhaps impossible, to find a hollow tree untenanted by *Apis mellifica*.

Dr. Gerstäcker divides the genus *Apis* into two groups, each being characterized by different structural peculiarities. After an extensive examination of species, I find two of the characters made use of inconstant, as applied to these divisions, but very useful in the determination of species. I have omitted them in the characteristics of the groups, and will point out the use made of them in dividing the species. The first character consists of the number of transverse rows of short hairs or bristles which line the inside of the metatarsus of the posterior legs. In the division of the Honey-Bees into two groups, those of the first are said to have "thirteen rows of bristles on the inner side of the metatarsus." I make the number of rows to be fourteen. I place two species in this division, and both are so characterized. In the second division, however, the character laid down, as in part distinguishing them (the "metatarsus of the hind legs with nine transverse rows of bristles on the inside"), cannot be retained. In order to ascertain correctly whether the species varied in this particular, I broke off the metatarsal joint from a large number of my specimens, and, having removed the bristles, I was enabled to ascertain with facility the exact number of rows in all the species. The figures given in illustration of this paper show the number in each: in counting the rows, that at the apical margin is, in all instances, included. I presume, such was not the case in drawing up the characters in Dr. Gerstäcker's paper, otherwise the first division would have fourteen rows.

The result of my examination of the different species of the genus *Apis* shows that *Apis dorsata* and *A. zonata* have each fourteen rows of bristles on the metatarsal joint; *A. mellifica*, *A. florea*, and *A. indica* have each ten rows; *A. Adansonii* has nine, and *A. nigro-cincta* eleven rows—a most satisfactory result, since it confirms me in my opinion, founded upon other characters, of the genus *Apis* consisting of more than four

species, the number given by Dr. Gerstäcker in his elaborate memoir.

By reference to the plate, it will be at once seen that the form of the posterior leg of the males of the different species is so distinctively different, that this single character alone is sufficient proof of their being distinct species, although the posterior leg in the other sexes only exhibits slight modifications of form in the metatarsal joint; but these, although less marked, are constant.

The rows of stiff hairs or bristles on the metatarsal joint are each situated on an elevated ridge; so that when the bristles are removed there is no difficulty in reckoning the number.

Group I. Vertex distinctly narrowed by the large compound eyes, so that the posterior ocelli are more distant from each other than from the eyes. In the anterior wings the recurrent nervure issues very near the apex of the third submarginal cell.

Sp. 1. *Apis dorsata*, Fabr. Syst. Piez. p. 370, ♂. (India.)

?*Apis nigripennis*, Latr. Ann. Mus. Hist. Nat. v. 170, ♂. (Bengal.)

— *bicolor*, Klug, Mag. der Gesell. Nat. Fr. zu Berlin, (1807) p. 264, ♂. (India.)

— *zonata*, Guér. Voy. Bélang. Ind. p. 504, ♂. (Coromandel.)

— *testacea*, Smith, Proc. Linn. Soc. ii. 49, ♂. (Borneo.)

(Additional habitats known are Malacca, Ceylon, Java, Sumatra, Flores, and Timor.)

Of this species I possess a good series of varieties of the worker Bees and two males; the latter sex has not been previously noticed: one specimen from Bombay is reddish yellow, with the thorax above, the scape of the antennæ, and the outside of the posterior tibiæ and of the metatarsus black; the thorax and two basal segments of the abdomen are clothed with long pale-reddish hair, intermixed with darker hairs on the disk of the thorax; wings colourless, and much more ample than in the worker Bee.

The second male is that of the pale variety, *Apis testacea*, first taken in Borneo, by Mr. A. R. Wallace, and subsequently in the island of Timor; it is entirely of a pale testaceous yellowish red; the thorax and two basal segments of the abdomen densely clothed with long pale-yellow hair; the wings clear hyaline. Except in coloration, these specimens agree in every particular; the posterior legs are precisely of the same form and length. Had I not possessed the male of this variety, I should have deemed it advisable to regard *A. testacea* as a distinct species. The exact correspondence of the two males in their form and proportions I consider conclusive of their being mere climatal varieties. I am informed by Mr. Wallace that he captured this pale variety on the wing in Timor, and that it sus-

pends its combs from the branches of trees, without any outward protection. This, I am informed by Sir John Hearsey, is also the habit of *A. dorsata* in India. This species varies greatly in the coloration of the abdomen. I have seen the following varieties:—

- a. Head and thorax black; abdomen yellow, with the apex more or less dusky; the anterior wings brown, palest at their posterior margin. (*Apis dorsata*, Fabr.)
- b. Like the previous variety, but with the wings hyaline. India.
- c. Black, with only the two basal segments of the abdomen yellowish red. (*Apis bicolor* and *A. zonata*.)
- d. Varies in having the three basal segments of the abdomen reddish yellow, and a band of white pubescent pile at the base of the fourth and fifth segments; anterior wings brown. Timor.
- e. The head and thorax black, and clothed with pale pubescence; the abdomen and legs entirely pale testaceous; wings hyaline. (*A. testacea*.) Borneo and Timor.

I have added a mark of doubt to the synonym *A. nigripennis* because I do not feel quite satisfied of its being distinct from the next species. I have seen examples of a black Bee from the Philippines which may prove to be a climatal variety of *A. dorsata*: it has not the ocelli so large as the next species.

Sp. 2. *Apis zonata*, Smith, Proc. Linn. Soc. iv. 8, ♀. (Celebes.)

Apis dorsata, Gerst. Ann. & Mag. Nat. Hist. (1843) xi. 344, nec Fabr.

This species is entirely black; it is the largest at present known of the genus; it is 9 lines long, whilst the *A. dorsata* I never found to exceed $7\frac{1}{2}$ lines. The abdomen, in all the specimens that I have seen (nineteen or twenty), is very convex above, and is adorned with a band of snow-white, short pubescent pile on the basal margins of the third, fourth, and fifth segments; these bands are continued beneath. Dr. Gerstäcker considers this species as an extreme variety of *A. dorsata*; but in this I cannot agree. The size, colour, and convexity of the abdomen are different, in addition to which I find a difference in the form of the metatarsus; the ocelli are proportionally larger, and the face is not pubescent. These may be regarded as slight differences; but, as I have already remarked, the specific distinctions among the workers of the different species of Honey-Bees are always extremely slight. The capture of the other sexes will, no doubt, decide this question; but I am inclined to believe that *A. zonata* will prove to be a good species.

Group II. Vertex not perceptibly narrowed; the posterior ocelli not more distant from each other than from the compound eyes. The recurrent nervure distant from the apex of the third submarginal cell.

Sp. 3. *Apis mellifica*, Linn. Faun. Suec. p. 421. no. 1697, ♀.
(Europe.)

Apis ligustica, Spin. Ins. Ligur. i. 35. 15. (Italy.)

— *fasciata*, Latr. Ann. Mus. Hist. Nat. v. 171. (Egypt.)

— *cerifera*, Scop. Ann. Hist. Nat. iv. 16. (Europe.)

— *gregaria*, Geoffr. Ins. ii. 407. (France.)

— *domestica*, Ray, Hist. Ins. p. 240. (England.)

Of the unicolorous form of this species I have seen specimens from nearly all parts of Europe, from most of the West-India Islands, from New York, Canada, Florida, Texas, California, and Mexico, from the Cape of Good Hope, Sierra Leone, Australia, and New Zealand; of the Ligurian form, examples from Italy, Switzerland, and the Cape of Good Hope.

Sp. 4. *Apis Adansonii*, Latr. Ann. Mus. Hist. Nat. v. 172, ♀.
(Senegal.)

Apis scutellata, St. Farg. Hym. i. 404, ♀. (Africa.)

— *nigritarum*, St. Farg. Hym. i. 406. (Congo.)

— *Caffra*, St. Farg. Hym. i. 402. (Africa.)

?— *unicolor*, Latr. Ann. Mus. Hist. Nat. v. 168. (Madagascar.)

— *mellifica*, Gerst. Ann. & Mag. Nat. Hist. 1863, vol. xi., nec Linn.

As I have before remarked, Dr. Gerstäcker regards this species, together with its varieties, as identical with *Apis mellifica*. My reasons for differing from him will be found in the foregoing remarks. I have also ascertained that the Honey-Bee is found in Zambesi: this small form I am inclined to consider a native species, widely spread over the vast expanse of Africa. The capture of the male will in all probability prove the truth of my conclusions. The *Apis unicolor* I have never seen; I have therefore expressed a doubt as regards its synonymy.

Sp. 5. *Apis indica*, Fabr. Syst. Piez. p. 370, ♀. (India.)

Apis Peronii, Latr. Ann. Mus. Hist. Nat. v. 173, ♀. (Timor.)

— *Delessertii*, Guér. Icon. Règ. Anim. 461, ♀. (Pondicherry.)

— *Perrottetii*, Guér. Icon. Règ. Anim. 461, ♀. (Neelgherries.)

— *socialis*, Latr. Ann. Mus. Hist. Nat. iv. 172, ♀. (India.)

— *dorsata*, St. Farg. Hym. i. 405, ♀. (India.)

(To the above localities may be added Java, Sumatra, Flores, Malacca, and Borneo.)

Sp. 6. *Apis nigro-cincta*, Smith, Proc. Linn. Soc. v. 93, ♀.
(Celebes.)

Apis indica, Gerst. Ann. & Mag. Nat. Hist. 1863, vol. xi. 343, nec Fabr.

This species has also been received from Borneo and China—

several specimens from the latter locality, all found near Shanghai. It is probable that the species described in this paper as *Apis sinensis* may prove to be its male: it was taken with the above-mentioned specimens. Dr. Gerstäcker regards this species as a variety of *Apis indica*, and places it among the varieties of that species which are characterized as having only the anterior part of the first and the basal half of the second segment yellow, the remainder blackish brown; my description is, with the abdomen entirely pale reddish yellow, and a narrow black band on the apical margin of all the segments.

I consider the species distinct from *A. indica* for the following reasons: it is uniformly larger, and has proportionally larger ocelli, the anterior one being more advanced and forming a more acute triangle; in front of the anterior ocellus is a strongly impressed channel, which passes down to the clypeus. These characters will probably be considered slight ones; but we must bear in mind that the distinctive specific characters in the genus *Apis* are slight in the working Bees, only one instance, as I have already observed, being known to the contrary, in *A. dorsata*.

Sp. 7. *Apis florea*, Fabr. Syst. Piez. p. 373, ♀. (India.)

Apis andreniformis, Smith, Proc. Linn. Soc. ii. 49, ♀. (Borneo.)

— *lobata*, Smith, Cat. Hym. Ins. Apidæ, ii. 416, ♂. (India.)

— *indica*, Latr. Ann. Mus. Hist. Nat. v. 169, ♀. (India.)

On a careful examination of *A. andreniformis*, I am inclined to consider it an extreme variety of *A. florea*: that species has the two basal segments of the abdomen red; but I have others in which the abdomen is entirely red, the apical segment being slightly fuscous: I find that it varies in colour much more than I was aware of when I described the species. The example upon which I founded it is the only one that I have seen with the abdomen entirely black, the second segment being narrowly rufo-fuscous at the basal margin, whilst the basal margins of the third, fourth, and fifth segments have each a narrow band of white pubescent pile. Dr. Gerstäcker has ascertained that this species is the *Anthophora florea* of Fabricius; he has also received the worker Bees from Ceylon, together with specimens of my *Apis lobata*: for this reason *A. lobata* is assigned as the male; if such prove to be the fact, it will be the first instance of such a vast discrepancy in size occurring in the genus *Apis*, the average size of the worker Bee being $3\frac{3}{4}$ lines, whilst *A. lobata* is 5 lines. I am, however, inclined to Dr. Gerstäcker's opinion, since he has had an opportunity of examining combs of *A. florea*, and he observes that the drone-cells are very large.

Sp. 8. *Apis sinensis.*

Length 5 lines.

This species is of the same colour and general form as the male of *A. mellifica*; but the neuration of the anterior wings is different; the recurrent nervure enters the third submarginal cell nearer to its apex; the difference in the form of the posterior tibiæ is also a distinctive specific character. (See Pl. XIX. fig. 4.)

EXPLANATION OF PLATE XIX.

- Fig. 1. Posterior leg of the male of *Apis mellifica*.
 Fig. 2. " " " *Apis dorsata*.
 Fig. 3. " " " *Apis florea*.
 Fig. 4. " " " *Apis sinensis*.
 Fig. 5. Posterior leg of the Worker Bee of *Apis mellifica*.
 Fig. 6. " " " *Apis Adansonii*.
 Fig. 7. " " " *Apis zonata*.
 Fig. 8. " " " *Apis dorsata*.
 Fig. 9. " " " *Apis nigro-cincta*.
 Fig. 10. " " " *Apis indica*.
 Fig. 11. Posterior metatarsus, showing the number of transverse rows of bristles to be fourteen in *Apis dorsata*.
 Fig. 12. Showing the number to be nine in *Apis Adansonii*.
 Fig. 13. " " " eleven in *Apis nigro-cincta*.
 Fig. 14. " " " ten in *Apis indica*.
 Fig. 15. " " " ten in *Apis mellifica*.
 Fig. 16. " " " ten in *Apis florea*.

XXXVIII.—On *Raphides and other Crystals in Plants.*

By GEORGE GULLIVER, F.R.S.

[Continued from p. 212.]

Bromeliaceæ.—Besides the species of this order noticed in the 'Annals' for May last I have examined leaves of *Dasyllirion filiforme* and *D. acrostichum*, in which are a few raphides (more abundant in the pale bases of the leaves), crystal prisms, and sphaeraphides; and a leaf of *Bonapartea gracilis*, which affords a profusion of raphides and a few larger crystal prisms.

Commelinaceæ.—To the former observations ('Annals,' June 1864) it may be added that *Tradescantia discolor* is also a raphis-bearing plant: a number of small quadratic crystals, or such octahedrons as were described in *Tradescantia* by Schleiden, I have likewise seen in the leaves and stem of *Tradescantia* and *Commelina*.

Araceæ.—Of the different tribes of this order in Prof. Balfour's 'Manual of Botany,' I have examined several species during last summer, and repeated and confirmed the observations given in the 'Annals' for May 1861, Sept. (page 228) and Nov. 1863,